International Space Station Considerations

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Manifesting

- Attached payload sites are allocated to and belong to the Enterprises, managed by the RPOs
  - Code Y owns 25% attached payload sites
  - AA determines how to use the allocation
- Individual pallet and JEM-EF topologies are worked by RPOs, ISS Program, and International Partners
- OES has placeholders on nadir pallets

Manned Flight Safety

- STS and ISS safety review system combined for flight and ground
  - Must pass through JSC Payload Safety Review Panel (PSRP)
- Substantial documentation increase over ELVs
- Significant safety oversight required
  - Safety and hazard verification
  - Safety engineer is a necessity
- Level of rigor independent of payload size or $ value
  - 3 step review process
  - Phase 1 review within 3 months of PDR

Viewing

- Truss sites will have partial, periodic obstruction of viewing by solar arrays, visiting vehicles, other instruments
  - Payloads won't be operating during visiting vehicle proximity operations
- Software tools for field-of-view analysis on ISS have been developed by several organizations
  - Top level analysis can be accommodated by the RPO
  - Sources available for more detailed or time-consuming analysis

Guidance Navigation & Control

Attitude Knowledge/Pointing

- ISS attitude knowledge will be reasonably well known and stable, but knowledge at the location of payload may need to be augmented
  - Nadir truss payloads have limited view of GPS constellation and currently no direct access to star tracker data
  - JEM-EF payloads have simultaneous capability for nadir viewing and star tracker data
  - Columbus EPF payloads will have partial GPS viewing
- ISS attitude holding requirement (2.5 degrees per axis per orbit) may need to be augmented by payload pointing (e.g., HEXAPOD for SAGE III)

Guidance Navigation & Control

- ISS induced jitter environment and requirements on payload induced disturbances need to be characterized for all sites
  - Preliminary induced environment number available for full truss sites only
  - Requirements documented for full truss and pallet payloads

Altitude

- Can vary from 190 to 250 nmi with smaller short-term variations superimposed on longer solar-cycle induced variation
  - Attitude reboost anticipated approximately every 3 months

Power

- Power duty cycle and operational scenarios are not yet characterized
- Power allocations will be less than site capabilities
  - Allocations and related policies are in the process of being worked
  - Allocations for all resources are shared between
    - NASA and the International Partners
    - RPOs
    - RPO distributes to payloads
- Survival Power for pallet payloads
  - 28V only for heaters during shuttle transportation
  - 120V only for heaters on pallet

Thermal

- Thermal
  - Limited capability to reject heat on EXPRESS Pallet sites
    - The EXPRESS Pallet itself has no active thermal control system for payloads
  - Radiated heat from neighboring payloads must be considered at all sites

Data Handling / Communication

- Command via S-band by file transfer or individual commands
- Telemetry via KU band with incomplete coverage
- ISS only provides data storage for data being dumped to the system during communication outage
  - Payloads must provide own storage for science data and capability to burst at max high rate (6 Mbps on pallet)
- Allocations are still in preliminary discussions

Contamination

Environment

- Molecular Deposition of the ISS Environment = 130A/yr
- Do not have a consistent, station-wide monitoring program

Payload Contamination

- Requirements for full truss and pallet payloads
  - Molecular column density along unobstructed line of sight from other truss payloads not to exceed $1x10^{-14}$ molecules/cm^2 per species
  - Molecular deposition not to exceed $1x10^{-14}$ gm/cm^2/sec on other attached payloads
  - Molecular deposition not to exceed $1x10^{-15}$ gm/cm^2/sec on ISS sensitive surfaces
- Requirements for JEM-EF not yet defined
- ASTM-E1559 testing data required for materials
  - Materials lists will be worked with ISS contamination group

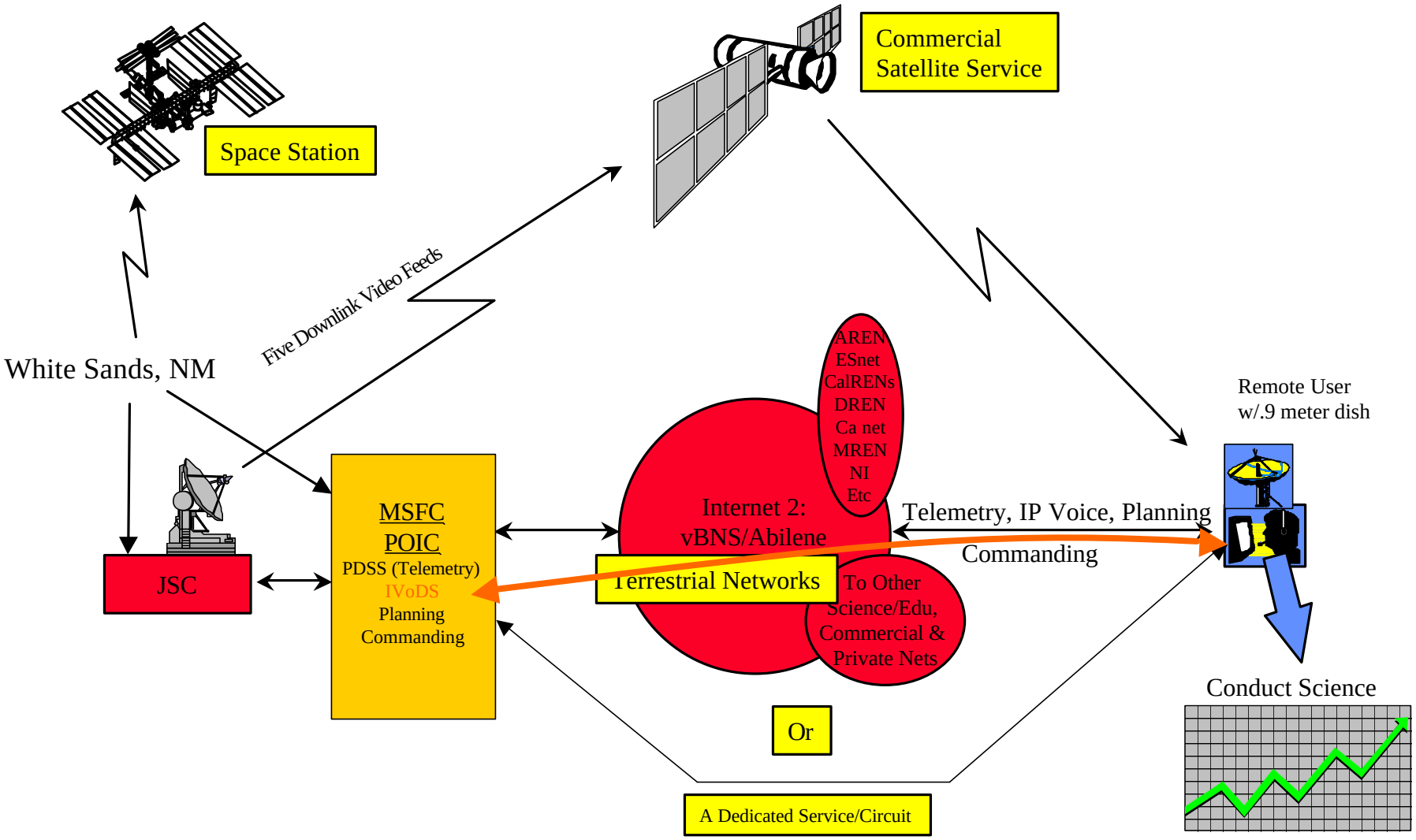
Simulators

- Simulators
  - Simulator resources for payload developers may be inadequate
  - May need to plan on using KSC payload test and checkout resources for risk mitigation
    - Scheduling of resources and cost could become an issue

Crew Time and Training

- Crew training and crew time are limiting resources
  - Advisable that attached payloads limit payload required crew interaction on orbit as much as possible
- “Standard” operations don’t require Payload Developer (PD) input, e.g. robotic placement
- Unique payload handling on-orbit requires training procedures, documentation
- Crew familiarization package to be provided by PD
- Contingency operations involving crew intervention will require ground or on-board training

Operations


Space Station
Commercial Satellite Service
Five Downlink Video Feeds
White Sands, NM
JSC
MSFC
POIC
PDSS (Telemetry)
IVoDS
Planning
Commanding
AREN
ESnet
CalRENs
DREN
Ca net
MREN
NI
Etc
Internet 2:
vBNS/Abilene
Terrestrial Networks
To Other
Science/Edu,
Commercial &
Private Nets
Telemetry, IP Voice, Planning
Commanding
Remote User
w/.9 meter dish
Conduct Science
Or
A Dedicated Service/Circuit

Operations

- Code Y will not have a Telescience Support Center (TSC)
- Individual payloads will provide operations connected directly to MSFC Payload Operations Integrated Center (POIC)
  - Telescience Resource Kit (TReK) software provided by ISS at minimal cost for command and telemetry
  - TReK can run on desktop computer in a secure environment
  - Can have TReKs in multiple locations with one site designated for commanding

Retrieval

- Payloads must be returned to ground
- Retrieval planning must take place prior to launch
- Payload anomalies and configuration changes must be tracked while on-orbit
- Safety re-assessment requires original design documents and operations records be maintained
- Retrieval Certification of Flight Readiness (CoFR) and Safety review required
- De-integrate from STS and return payload to PI
- MO & DA budget must include reserved retrieval costs

Recommended Reading

- EXPRESS Pallet Interface Definition Document, Working Draft 5
  - SSP 52000-IDD-EPP
- EXPRESS Pallet Payload Accommodation Handbook, Working Draft 3
  - SSP 52000-PAH-EPP
- EXPRESS Pallet Generic Payload Verification Plan, Working Draft 3
  - SSP 52000-PVP-EPP
- Payload Integration Requirements Document for Unpressurized Payloads
  - SSP 57061
- Payload Integration Requirements Document Increment Addendum Blank Book
  - SSP 57062
- Space Station Program Requirements for Payloads
  - SSP 50431
- Space Station GN&C Overview for Payloads

Recommended Reading

- Also available on the RPO website
  - Typical Schedules
  - Reviews
  - Deliverables
- ISS documentation typically located behind firewalls at JSC, MSFC
  - Can request what you need through RPO
  - Register with JSC for access
- Payload Data Library (PDL)
  - In addition to document deliverables, payload data is entered into the PDL on-line
  - Data is used by multiple organizations, limiting redundant request to payload developers

Contact Us

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